SOIL-GAS SURVEY REPORT FOR THE OLD MILL SITE ROCK CREEK, OHIO DECEMBER, 1988

by

Lockheed Engineering and Sciences Company
1050 East Flamingo Road
Las Vegas, Nevada 89119

for

United States Environmental Protection Agency
Region 5, Chicago Illinois

through

Superfund Technology Support Center for Monitoring
and Site Characterization
United States Environmental Protection Agency
944 East Harmon
Las Vegas, Nevada 89193-3478

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1.0 Introduction

Lockheed Engineering and Sciences Company (LESCO) is engaged in Superfund technology support under contract 68-03-3245 to the U.S. Environmental Protection Agency (EPA) Environmental Monitoring Systems Laboratory in Las Vegas, Nevada (EMSL-LV). EPA Region 5 called upon EMSL-LV to provide a short-notice soil-gas survey at the Old Mill Site in Rock Creek, Ohio where contamination by chlorinated solvents was unexpectedly found. The objective of the survey performed by LESCO under the LESCO technology support task was to use soil-gas sampling and analysis to provide a cost- and time-effective indication as to the lateral and down-gradient extent of the contamination for the purpose of redesigning the remediation program.

1.1 Nature of Problem

During the removal of topsoil from a zone at the site originally thought to be clean of contaminants, increasing contaminant concentrations were discovered. A hole in the area of highest concentration was allowed to fill with ground water. The ground water was analyzed and found to contain high levels of xylenes, trichloroethylene (TCE), perchloroethylene (PCE), and vinyl chloride. The source as well as the degree this contamination were unknown, resulting in an immediate need to determine the extent of the contamination in order to facilitate redesign of the remediation plan to accommodate the unexpected contamination.

2.0 Site Description

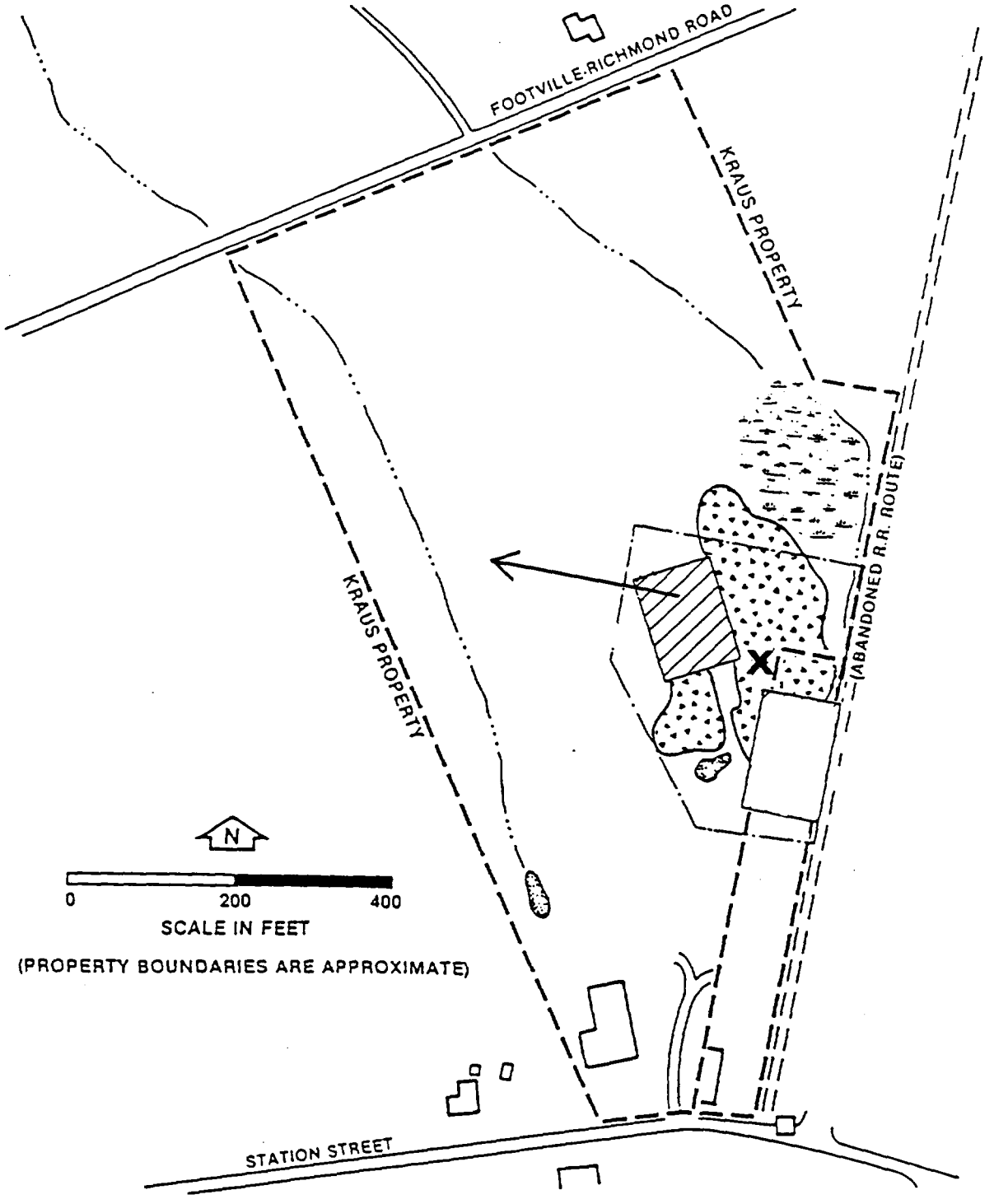
The site of investigation is centrally located in the Kraus property of the Old Mill Site in Rock Creek, Ohio (Figure 1). The area near the location of contamination was previously treated for surface contamination by removal of the topsoil (exclusion zone, Figure 1). The contamination was discovered at the north center of the exclusion zone during the removal of topsoil, near soil-gas sampling points 1 and 2 (Figure 2). Groundwater is located at approximately 7 feet below the surface and flows northwest. The topsoil, the primary horizon used for soil-gas sampling, consisted mainly of clayey silt and the area to the north and west of the exclusion zone is undeveloped field.

3.0 Scope of Work

The data and results discussed in the following section involved in situ soil-gas measurements with on-site analysis.

3.1 In Situ Soil-Gas Measurements with On-Site Analysis

The in situ soil-gas measurements consisted of 23 sampling points



KEY
- MARSHY AREA
- STOCKPILES OF RAILROAD BALLAST
- KRAUS PROPERTY DRAINAGEWAY
- Exclusion Zone
- X Approximate Location of Remediation Wells
- ← Direction of Groundwater Flow

Figure 1. Site Map

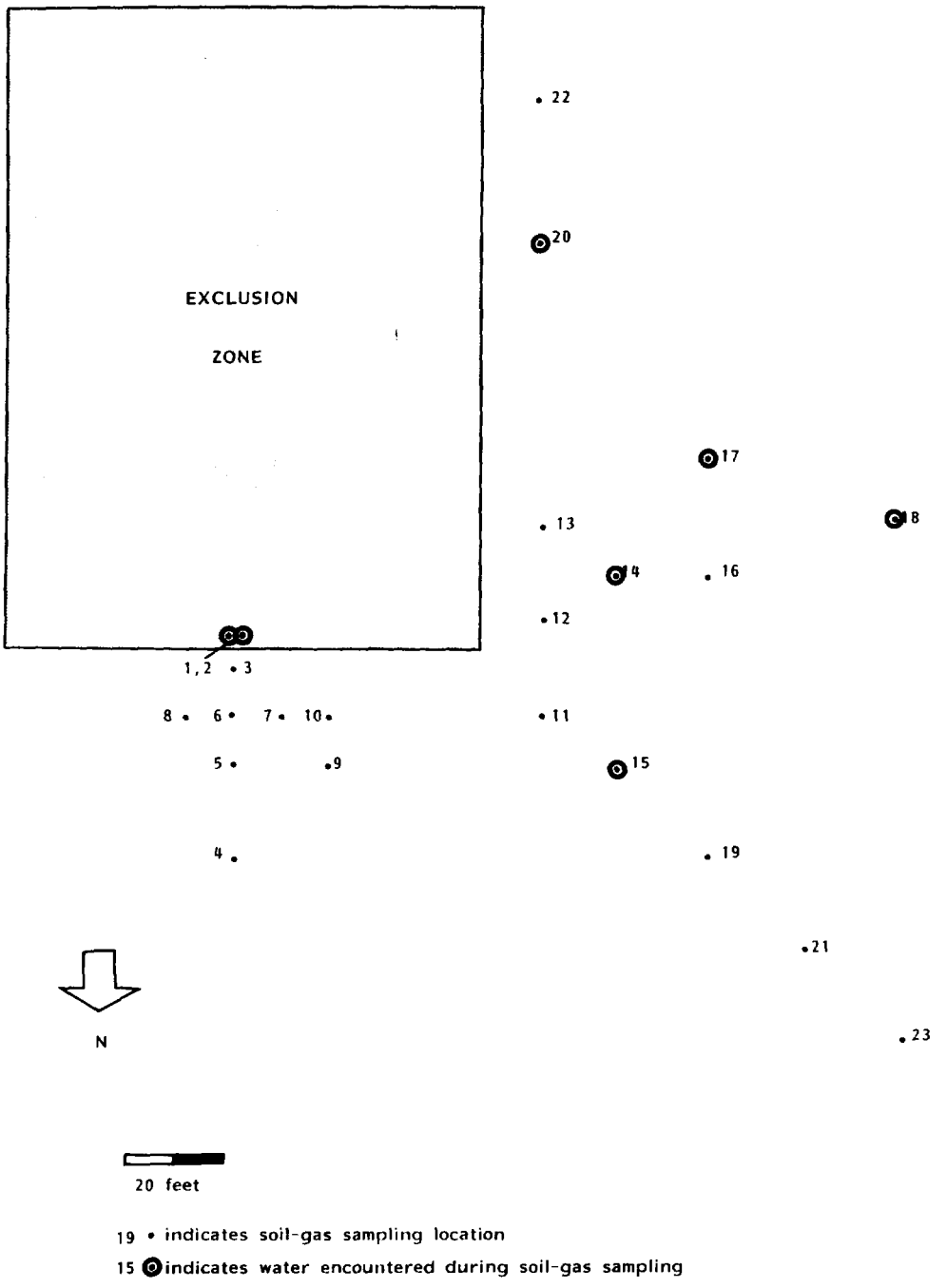


Figure 2. Soil-Gas Sampling Locations

near the exclusion zone (see Figure 2). Soil-gas samples were taken from depths of 3 to 5 feet using a 0.25-inch OD/0.125-inch ID stainless steel probe. Probe emplacement consisted of first hammering a 1-inch driving bar into the ground to depth. The bar was removed and the probe was inserted in the void and backfilled with clean sand. With the probe in place, a manifold with septum was attached as was a 100-cc MSA vacuum pump. Samples were taken through the septum using a clean syringe after 200 cc (two pump volumes) was purged through the line. The sample was taken immediately to the field trailer for analysis.

Analysis of samples was by SRI Model 8610 gas chromatograph (GC) with a Megabore DB-624 column and a photoionization detector (PID) in series with an electron capture detector (ECD). The PID was used to detect compounds with double bonds such as aromatic hydrocarbons and PCE and TCE. The ECD was used for its sensitivity to chlorinated compounds (TCE, TCA, PCE) and provided the data used for contouring.

3.1.1 Quality Assurance/Quality Control

The quality assurance/quality control (QA/QC) applied to this field work and analysis involved two portions, equipment QA/QC and sampling QA/QC.

The QA/QC for the equipment used N_2 blanks to verify cleanliness in syringes, probes, pumps, and manifolds. N_2 blanks were also run through the GC as well as ambient air samples to ensure column and working environment cleanliness. Injections of known concentrations of analytes (standards) were used to determine GC calibration and response factor.

Sampling QA/QC involved duplicate samples from each probe (Table 1) and day 1/day 2 sampling (Table 2) of a single probe. These QA/QC checks were used to estimate the degree of comparability between samples taken consecutively (duplicates) and also of samples taken days apart (day 1/day 2 samples). Labeled syringes containing samples were logged in a field notebook as well as on a lab sheet

A QA/QC test not able to be performed due to the degree of saturation of the soil was that of confirmation/calibration. This test involves sampling soil gas near a location of known contamination, determining i) if a response by the GC is a true indication of a particular level of contamination, and ii) the response of the GC at a location of known contamination. At the site, the only area of known contamination was at the north end of the exclusion zone where a ground water sample was taken. Our attempts at this location resulted in water in the probes and not soil-gas samples for use in calibration.

TABLE 1

Old Mill Site, Rock Creek, Ohio

ECD Results

Probe Location	TCA (ng/cc)	TCE (ng/cc)	PCE (ng/cc)
2	NS*	NS	NS
3	0.21	0.0	0.0
4	0.28	0.0	0.01
	0.35	0.0	0.0
5	0.10	0.0	0.0
	0.08	0.0	0.0
6	0.15	2.40	0.09
	0.27	4.90	0.24
7	0.0	0.0	0.39
	0.0	0.0	0.2
8	0.6	0.0	0.0
	0.0	0.0	0.0
9	0.0	0.0	0.0
	0.0	0.0	0.0
10	0.0	0.48	0.05
	0.13	0.81	0.04
	0.14	0.94	0.06
	0.05	0.53	0.0
11	0.21	8.48	0.12
	0.38	13.7	0.25
12	0.17	6.04	0.0
	0.31	17.2	0.17
13	0.17	19.4	0.03
	0.31	17.2	0.17
16	0.20	0.16	0.0
	0.05	0.76	0.0
17	NS	NS	NS
19	0.28	13.6	0.0
	0.38	26.8	0.05
21	0.0	4.49	0.0
	0.0	4.45	0.0

TABLE 1

Old Mill Site, Rock Creek, Ohio

ECD Results

Probe Location	TCA (ng/cc)	TCE (ng/cc)	PCE (ng/cc)
22	0.0	0.59	0.0
	0.25	0.46	0.0
23	0.39	0.26	0.16
	0.0	0.33	0.0

* Not Sampled

TABLE 2

Old Mill Site, Rock Creek, Ohio

ECD Results of Day1/Day 2 Sampling (All Concentrations in ng/cc)

Date	Probe Loc	TCA	TCE	PCE
12-1-88	5	0.10	0.0	0.0
		0.08	0.0	0.0
12-2-88	5	0.0	0.0	0.0
		0.0	0.0	0.0
12-2-88	6	0.15	2.4	0.09
		0.27	4.9	0.24
12-3-88	6	0.0	5.78	0.0
		0.0	0.20	0.0

TABLE 3

Old Mill Site, Rock Creek, Ohio

ECD Results of Headspace

Probe Location	TCA (ng/cc)	TCE (ng/cc)	PCE (ng/cc)
1	0.26	1.89	1.47
14	0.18	5.26	0.04
15	2.06	199	0.32
	18.2	516	0.92
18	0.27	3.58	0.0
	0.0	0.76	0.0
20	0.0	10.4	0.05
	0.0	9.92	0.0
Remedial Well (shallow)	ND*	4.92	ND
Remedial Well (deep)	ND	1.19	ND

*ND indicates non-detect

4.0 Results and Discussion

Table 1 provides soil-gas concentrations for TCE, TCA, and PCE. Figure 3 shows an isoconcentration contour map for TCE (the only compound detected at higher levels) as detected by GC/ECD.

Examination of Figure 3 indicates TCE concentrations in the soil gas of 1 ng/cc extending northwest and to a lesser extent west of the exclusion zone. For comparison purposes, the gas-phase concentration of pure TCE (e.g., soil concentration) would be slightly over 500,000 ng/cc. The presence of gradual contamination gradients as seen by the wide spacing of TCE contamination contours is indicative of ground-water contamination rather than of shallow soil contamination resulting from an event such as a recent surface spill.

Several factors encountered during the survey should be kept in mind during consideration of this data. First, an unsaturated zone could not be found at several locations, resulting in water of unknown origin (groundwater, surficial recharge, combination of the two) in the sampling probe during the purging portion of sampling (Figure 2). In an effort to determine some indication of contamination, the water pressure was allowed to relax within the sealed probe, creating a headspace within the probe. This headspace was then sampled and analyzed for PCE, TCE, and TCA (Table 3). A correlation however, between these headspace measurements and soil-gas concentrations was not developed, leaving the headspace data unreferenced and unusable. Second, interpretation of the soil-gas data should probably assume only order-of-magnitude changes between sampling locations as meaningful. This rule results from the fact the vadose zone conditions did not allow closely spaced samples to provide an estimate of the (site-specific) inherent overall variability of results, in order to estimate how much of a change in soil-gas concentration is meaningful. Third, data could not be obtained to determine the relationship between soil-gas concentrations and underlying ground-water and soil contamination levels thereby allowing the estimation of underlying contaminant concentrations from the soil-gas data. Hence, the underlying ground-water contamination concentration associated with the outer contour line cannot be estimated with any measurable confidence and contamination at detectable concentrations in the groundwater may extend beyond the 1 ng/cc contour.

Two sets of data may provide some insight into a relationship between groundwater concentrations and the above-mentioned probe headspace concentrations. First, probe headspace concentrations found in Table 3 exhibit the same spatial pattern as the soil-gas data from Table 1. Second, a headspace sample was taken 4 feet below the collar of each of two remediation wells nearest the site (Figure 1). The wells were located approximately 200 feet upgradient from the nearest point of soil-gas detection (probes 1 and 2) and had not yet been analyzed but were considered clean. The well headspace analysis indicated up to 4.76 ng/cc of TCE

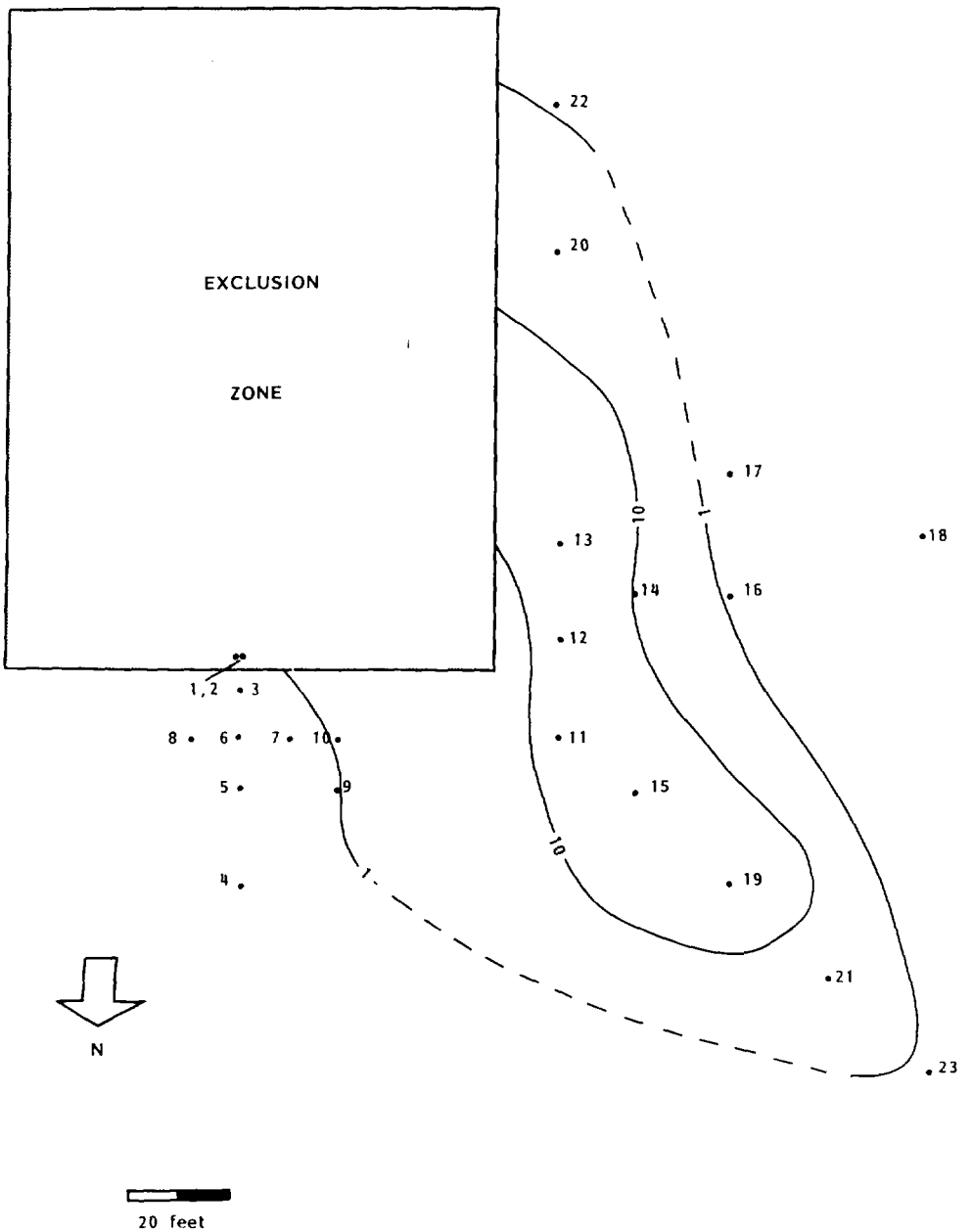


Figure 3. TCE Soil-Gas Concentrations

present in comparison to a range of 1.89 to 516 ng/cc of TCE for the probe headspace (Table 3). The comparison of these two data sets may indicate one of several situations: the wells may not be as clean as originally thought, vadose-zone gas-phase concentrations of up to 5 ng/cc could be present due to horizontal vapor migration, or the probe headspace values of <10 ng/cc, one order of magnitude above the well headspace concentrations, may not indicate significant contamination. Once again, this comparison is speculative and the probe-water headspace data should only be used as a reference.

5.0 Conclusions and Recommendations

5.1 Conclusions

The high degree of saturation of soils by surficial water and a limited vadose zone made correlations between soil gas concentrations detected and underlying ground-water concentrations difficult. Hence, the 1 ng/cc contour line on Figure 2 indicates a relative level of contamination, i.e., the line indicates a lower level of contamination when referenced to the area where contamination was found. The relatively low horizontal concentration gradients in the soil-gas data (Figure 3) are representative of ground-water contamination as opposed to shallow soil contamination, consistent with the site's shallow ground-water table and substantial surficial water recharge driving the contaminants to the water table.

5.2 Recommendations

- confirmatory ground-water samples should be taken to the north, west, and northwest of the Exclusion Zone in the vicinity of the 1 ng/cc contour; and

- ground water from the remediation wells should be analyzed to identify any contamination.